Establishment Record for Upper Sand Creek Research Natural Area within Dixie NF

COOP AGREEMENT NATURE CONSERVANCY

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ESTABLISHMENT RECORD FOR UPPER SAND CREEK RESEARCH NATURAL AREA WITHIN DIXIE NATIONAL FOREST GARFIELD COUNTY, UTAH

INTRODUCTION

The Aquarius Plateau is an extensive basalt-covered table-land that is one among a series of plateaus forming a north-south zone of highlands through the central part of Utah. Upper elevations of the Aquarius Plateau are occupied primarily by subalpine coniferous forests, stands of aspen and sagebrush, and open meadows. Flanks of this plateau support communities of aspen, Douglas-fir, white fir and ponderosa pine. On its southern margin the Aquarius Plateau falls away rapidly into the rugged sandstone canyons of the Escalante River drainage.

Prehistoric pueblo people were scattered throughout south-central Utah in the early part of the second millennium A.D. Indigenous people of various tribes were present in the region when the first European explorers and settlers traversed the region. C.E. Dutton of the 1872-77 Powell Survey made perhaps the first recorded observations of the Aquarius Plateau country. Also at this time, exploration parties of the LDS Church were looking at the feasibility of settling the country south of the Aquarius Plateau. Their scoutings led to the 1876 establishment of the town of Escalante.

These settlers relied to a great extent on natural resources available on the highlands to their north. Land uses such as timber harvest, summer livestock grazing, mineral extraction and dispersed recreation have proceeded from the growth of Escalante and other small towns in Garfield County, coupled with the evolution of National Forest management (Alexander 1987).

Complementing the multiple use of resources in this part of Utah is a need to maintain undisturbed examples of the area's natural diversity. A means of conserving undisturbed areas on National Forest lands is through administrative designation of Research Natural Areas (RNAs). These serve to register and protect certain ecosystems as benchmark or reference areas.

The southern margin of the Aquarius Plateau contains several peninsular benches or broad ridge crests that are perched above deep sandstone canyons draining southward to the Escalante River. One of these broad crests, between Sand Creek and Death Hollow, has been subject to little resource use or development due to its relatively isolated position. This area was "discovered" in July 1985 by the author of this Establishment Record, accompanied by a District timber staff person, during their searches for an area of moderately-productive ponderosa pine stands that could be included in the RNA system. A follow-up "reconnaissance" report was prepared (Tuhy 1987) that documented how this area, now known as Upper Sand Creek, was the best qualified among all of the prospective RNA tracts seen during these searches. It was too late, however, to include this area as a candidate RNA in the Dixie National Forest Land and Resource Management Plan (USDA Forest Service 1986b).

A Region-wide initiative was undertaken in the mid 1990's to achieve RNA designation for a handful of sites that had been previously identified as qualified, but for which formal action had not been taken. Upper Sand Creek was included in this process, and was visited by the author of this Establishment Record along with District staff people in June 1997. The opportunity now exists to recognize and protect the values of this area by designating it as the Upper Sand Creek Research Natural Area (USCRNA).

The USCRNA consists entirely of reserved lands of the Dixie National Forest. About 70% of the area lies within the Box-Death Hollow Wilderness. None of the USCRNA is within nor does it contain any other Congressionally-designated areas such as National Recreation Area or Wild and Scenic River.

Land Management Planning

The Regional Guide for the Intermountain Region (USDA Forest Service 1984) includes policy, general guidance, and Regional planning requirements for RNAs. The more recent Regional Desk Guide (USDA Forest Service 1993) reiterates that selection and establishment of RNAs shall be a part of the continuing land and resource management planning process. Relevant portions of these Regional documents are included in Appendix A.

The Dixie National Forest Land and Resource Management Plan ("Forest Plan"; USDA Forest Service 1986b) and Environmental Impact Statement (USDA Forest Service 1986a) contain more-specific policy and guidance for the establishment and management of RNAs on the Forest. Selected materials pertaining to RNAs from these two documents are included in Appendix B.

The Upper Sand Creek site was nominated as a candidate RNA as part of the continuing management planning process. However, it is not identified as a candidate RNA in the current Forest Plan. At present, the Forest Plan identifies the Upper Sand Creek site as being within portions of two Management Areas: 8A (Wilderness) and 8A2 (Other CO_2 Areas), of which the first is the largest. Emphasis in Management Area 8A is to provide for the protection and perpetuation of essentially natural bio-physical conditions. Emphasis in Management Area 8A2 is for the potential leasing and development of carbon dioxide (CO_2), coupled ultimately with maintenance of the natural or natural-appearing environment. As explained later in this Establishment Record, conflicts between these land uses and the values that make the Upper Sand Creek site qualified for RNA status appear to be minimal -- though CO_2 activity will be managed as the priority land management feature for as long as CO_2 leases exist.

The analysis and recommendations necessary for designating Upper Sand Creek as an RNA are contained within an Environmental Assessment (USDA Forest Service 1998b; Appendix C) and Dixie National Forest Plan Amendment (USDA Forest Service 1998a; Appendix D). The result of these analyses and the subsequent decision is to change the status of the Upper Sand Creek site to Management Area 10A, a Research Natural Area (while also retaining prescription 8A for the portion of the area within the Box-Death Hollow Wilderness).

OBJECTIVES

The chief objective of the Upper Sand Creek RNA is to preserve and maintain in undisturbed, naturally-functioning condition the biological and genetic diversity present within exemplary vegetation types and habitat occurrences within the area. These include outstanding examples of moderately-productive ponderosa pine forests; typical examples of mixed-conifer, less-productive ponderosa pine, and piñon pine-juniper communities; and distinctive landform, soil and geologic types.

Establishment and protection of the USCRNA will further the long-term objective of setting aside at least one example of all the habitat or vegetation community types represented on National Forest lands in Utah or Region 4 (Federal Committee on Ecological Reserves [FCER] 1977). As explained in the following section, the USCRNA contains four vegetation types that would be new to the RNA system within the Utah High Plateaus and Mountains geographic Section.

The USCRNA will also provide a reference site for basic, non-manipulative studies of biotic patterns, ecological processes, natural disturbance regimes and community succession. Left undisturbed by human intrusions, it will afford managers and conservation scientists a benchmark for assessing long-term ecological and geomorphological changes, plus inherent productivity (Passey et al. 1982). Such a benchmark would be especially useful for comparing the effects of resource management techniques and practices on nearby lands that are under timber and grazing management (Johnson 1989).

JUSTIFICATION STATEMENT FOR ESTABLISHMENT OF AREA

An initial estimate of RNA needs in Utah and Nevada listed "a ponderosa pine area typifying stands under commercial timber production" as a key RNA need for the Utah High Plateaus Province (Van Pelt 1982, Table 30). Follow-up conversations with knowledgeable land managers and scientists pointed to the Escalante Ranger District of the Dixie National Forest as the likeliest place to find a specific site that would meet this RNA need; this led to the searches mentioned in the **INTRODUCTION** section that found the Upper Sand Creek site.

A recent analysis of RNA needs on National Forest lands in Utah (Tuhy 1998) focused on vegetation types as the cells to be targeted for inclusion in the RNA system, segregated according to geographic divisions of the state known as Sections (McNab and Avers 1994). This analysis found that designation of the USCRNA would fill four new cells within the Utah High Plateaus and Mountains Section. Table 1 shows the specific cells that are represented in the USCRNA, all of which provide major representation in terms of substantial areal coverage.

Pertinent excerpts from the initial RNA needs estimate (Van Pelt 1982) and from the recent analysis (Tuhy 1998) are included in Appendix E, as documentation of the needed natural diversity elements.

Table 1. Specific cells represented in the Upper Sand Creek RNA, all of which fill unmet RNA cell needs in the Utah High Plateaus and Mountains Section.

TALL FOREST COMMUNITIES
Abies concolor/Quercus gambelii (white fir/Gambel oak)
Pinus ponderosa/Arctostaphylos patula (ponderosa pine/greenleaf manzanita)
Pinus ponderosa/Purshia tridentata (ponderosa pine/bitterbrush)
SHORT FOREST, WOODLAND AND SHRUBLAND COMMUNITIES
Pinus edulis-Juniperus osteosperma/Purshia mexicana (two-needle piñon pine-Utah juniper/cliffrose)

Designation of the USCRNA would also add a number of landform and geologic cells to the RNA system, according to the classifications in FCER (1977; pp. 14-19). Because these cell categories are not well-defined within the FCER document, however, a listing of such specific abiotic cells present in the USCRNA is not given here.

Another justification for establishment of the USCRNA involves the use of the area for research. Though no studies are known to be taking place within the area at the present time, the USCRNA could support extensions of existing, localized research focusing on specific communities and their ecotones (e.g. Austin 1987; Brotherson et al. 1984). Research on fire dynamics in ponderosa pine communities

has been done elsewhere by Crane (1982) and Madany and West (1980). The juxtaposition of contrasting geologic materials (igneous and sedimentary) in the USCRNA affords an opportunity to study vegetational differences based on parent material where climate is the same. Brooks (1970) conducted such an investigation on the west side of the Paunsaugunt Plateau.

PRINCIPAL DISTINGUISHING FEATURES

The USCRNA occupies the broad top of a peninsula-like ridge that is surrounded on three sides by deep sandstone canyons (Photo 3). Many of the northern and north-central portions of the area are underlain by basaltic materials originating from the high Aquarius Plateau to the north. These areas tend to be less steeply-sloping, and thus form a gently-undulating surface roughly above the 8200-foot (2500-m) level. Sedimentary rocks are exposed in the remainder of the area, which tends to be more dissected and steeply-sloping.

The USCRNA is most distinguished by the presence of open, park-like stands of mature ponderosa pine with low-shrubby and grassy understories (Photos 6-8). These stands are best developed on the gently-undulating terrain in the higher-elevation parts of the area. Locally cooler/wetter north-facing slopes support mixed stands of white fir, Douglas-fir and ponderosa pine (Photo 1), whereas some open ridge crests contain dense tall-shrub thickets of Gambel oak and birchleaf mountain mahogany (Photo 5). Lower-elevation portions of the USCRNA contain open forests of ponderosa pine and manzanita on sandstone substrates (Photo 9), and woodlands of two-needle piñon pine and Utah juniper on warm/dry south-facing slopes (Photos 3 and 4).

All of these features are present in little-altered or pristine condition. Unlike similar areas in the general region, the Upper Sand Creek site contains no significant evidence of human works, timber cutting or livestock grazing.

LOCATION

The Upper Sand Creek RNA is located on the Escalante Ranger District of the Dixie National Forest. It lies about 11 miles (18 km) north of Escalante, in north-central Garfield County (Maps 1-3). Latitude and longitude for the approximate center of the area are 37°56' North and 111°35' West, respectively. The least rectangle that includes the whole area is defined (to 30-seconds precision) by the following latitude/longitude lines: North - 37°57'30"N; South - 37°54'30"N; West - 111°36'30"W; East - 111°34'00"W. Specifically, the area lies in portions of unsurveyed sections 8, 9, 16, 17, 18, 19, 20, 21 and 29 of T33S R3E, Salt Lake Meridian (Maps 3-4). It is shown on the Roger Peak 7.5' topographic quadrangle. Stereo coverage is provided by six aerial photographs, housed at the Escalante Ranger District Office: 10-1-91 USDA-F 16 614070 1190-125 through 1190-130.

The boundary of the USCRNA (Map 4) corresponds with generally well-defined landform features for most of its length. The chief landform feature that is followed is the upper rim of the steep sandstone cliffs that drop off into adjoining canyons. A shallow drainage constitutes much of the northern boundary, and a segment of the northwestern boundary corresponds with the 8200-foot (2500-m) contour line. A description of the USCRNA boundary is provided in Appendix F. The boundary shown on Map 4 encompasses an area of 1880 acres (760 ha). Elevation ranges from 7600 feet (2315 m) along the southern margin of the area, up to 8562 feet (2610 m) on the top of a knoll in the north-central part of the area. This represents a vertical relief of 962 feet (295 m).

Access into the USCRNA is via Forest Road #153, the well-marked Hells Backbone Road. This is a well-maintained gravel road suitable for all types of vehicles, although portions of it can become very

slick in wet weather. It can be followed northward from Escalante, passing junctions to Posy Lake and Cowpuncher Guard Station, and crossing over Hells Backbone Bridge. This road can also be followed westward from its junction with Utah Highway 12 (a short ways west of Boulder), passing through Salt Gulch and crossing the drainage of Sand Creek. The closest parking spot from which to begin foot travel toward the RNA is the apex of a broad switchback located approximately 1.6 road miles (2.6 km) southeast of Hells Backbone Bridge, or 1.1 road miles (1.8 km) south-southwest of the crossing of Sand Creek.

The northern end of the USCRNA is slightly less than ½ mile (0.8 km) southward from the parking spot on the road. Access involves a cross-country hike, though there are some game paths that can be followed intermittently, and even the hint of a very old wagon road on the side of the ridge north of the RNA boundary. One cannot avoid patches of tall brush that occupy the approach route, though the going is easier below the ridge crest (on the eastern side) than on top of it.

Foot travel within the RNA varies according to vegetation conditions. Walking is easiest in the park-like ponderosa pine/bitterbrush stands, especially where the low understory shrubs are less dense. The ponderosa pine/manzanita stands of the RNA's southwestern corner are likewise open and afford easy walking. Conversely, dense thickets of mountain mahogany and Gambel oak on ridge crests and within mixed-conifer stands are very difficult to traverse, and some denser piñon-juniper woodlands can also present travel hindrances.

AREA BY COVER TYPES

The extent and distribution of vegetation cover types in the USCRNA has been derived from field surveys and subsequent aerial photo interpretation. Several systems for classifying such types are considered, as discussed below.

The Society of American Foresters cover type classification (Eyre 1980) applies to most of the vegetation within the USCRNA. The mixed-conifer forests (Douglas-fir, white fir and ponderosa pine) that occur mostly in the northern half of the area belong to SAF Type 210: Interior Douglas-fir, because Type 211 (white fir) is defined by Eyre (1980; p. 92) as being confined to the west coast. The forests of ponderosa pine, both with bitterbrush and manzanita understories, belong to SAF Type 237: Interior Ponderosa Pine. The woodlands of two-needle piñon pine and Utah juniper, principally on warm/dry sites in the area, belong to SAF Type 239: Pinyon-Juniper. Patches of tall shrubs (birchleaf mountain mahogany and Gambel oak) are not considered in the SAF system, though some (many?) of these may represent seral conditions in mixed-conifer forest communities.

The classification of potential natural vegetation by Küchler (1966) is likewise mostly applicable to the vegetation of the USCRNA. The mixed-conifer stands correspond to Type 19: Spruce-Fir-Douglas fir Forest (though spruce is absent). The forests of ponderosa pine probably correspond to Type 17: Pine-Douglas fir Forest (though Douglas-fir is absent), or possibly to Type 18: Arizona Pine Forest. Piñon-juniper woodlands correspond to Type 21: Juniper-Pinyon Woodland. The tall-shrub patches of birchleaf mahogany and Gambel oak would correspond to Type 31: Mountain Mahogany-Oak Scrub -- though in the USCRNA they are combined with the mixed-conifer stands (Küchler Type 19) for mapping and areal tabulation purposes.

The distribution of SAF cover types and Küchler types in the USCRNA is shown on Map 5. The map legend displays the correspondence ("cross-walking") between these two broad classification schemes for forest types. Table 2 shows the estimated areas of vegetation types defined by the SAF and Küchler systems. As on Map 5, the correspondence between these two classification systems for forest types is displayed in Table 2.

Table 2. Estimated areas of SAF and Küchler types in the Upper Sand Creek RNA.

COVER TYPE	TYPE NUMBER SAF (1980)	Küchler (1966)	ESTIMATED AREA Acres	Hectares
Mixed conifer (Douglas-fir-white fir) [*Abies concolor/Quercus gambelii* h.t.]	210	19	340	138
Ponderosa pine [*Pinus ponderosa/Arctostaphylos patula* h.t.] [*Pinus ponderosa/Purshia tridentata* h.t.]	237	17 (18?)	805	325
Piñon-juniper	239	21	655	265
No vegetation - rock outcrop	---	--	80	32
		TOTALS	1880	760

According to more-detailed classification work in the region by Youngblood and Mauk (1985), sites occupied by tall-coniferous trees in the USCRNA are identified as representative of three forest habitat types. The identities of these are shown in Table 2, and more detailed descriptions are contained in the **Flora and Communities** subsection of this Record. Table 3 shows the estimated areas of these types, chiefly distinguishing between the two ponderosa pine types, both inside and outside the Box-Death Hollow Wilderness.

Table 3. Estimated areas of more-detailed vegetation/habitat types, within and outside the Box-Death Hollow Wilderness, in the Upper Sand Creek RNA.

TYPE	INSIDE WILDERNESS Acres	Hectares	OUTSIDE WILDERNESS Acres	Hectares	TOTAL Acres	Hectares
Abies concolor/Quercus gambelii h.t. [Mixed-conifer stands and tall brush patches]	135	55	205	83	340	138
Pinus ponderosa/Purshia tridentata h.t.	275	111	270	109	545	220
Pinus ponderosa/Arctostaphylos patula h.t.	260	105	0	0	260	105
Piñon-juniper	535	217	120	48	655	265
No vegetation - rock outcrop	80	32	0	0	80	32
TOTALS	1285	520	595	240	1880	760

PHYSICAL AND CLIMATIC CONDITIONS

The USCRNA occupies the broad top of a ridge that extends like a peninsula from the flank of the Aquarius Plateau out into much lower terrain. In this respect, the RNA simulates a mesa that is connected to a "mainland" by a relatively narrow neck on one side (northern), and is surrounded by deep sandstone canyons on the other three sides (Photo 3). In the northern ⅔ of the USCRNA, roughly above the 8200-foot (2500-m) contour, the crest of the peninsula-like ridge forms an undulating surface with mostly short, gentle-gradient slopes (Photos 1 and 2). Much of this upper terrain is underlain by basaltic materials originating from the high plateau to the north. Below these upper elevations, much of the remainder of the USCRNA is characterized by moderate-gradient slopes of sedimentary rocks (Carmel Formation) that are dissected by shallow drainage courses. Flatter terrain in the southwestern part of the USCRNA represents the exposed upper surface of the Navajo Sandstone (Photo 9). Much of this sandstone surface exhibits a series of elongated low ridges and intervening shallow slot-like depressions, characteristic of the Navajo's joint-like erosion pattern through much of the canyon country.

The Land Systems Inventory for the Escalante Ranger District provides the following summary of general climatic conditions for the area:

> Three major storm systems determine the precipitation regime of the District. The first is the storm system from the Pacific. These storms move into the region over the Pacific Northwest and the northern California coast. Precipitation from these storms is mostly snow. The second storm system is the high-altitude, low-pressure system that develops over Nevada and southwestern Utah from October to April. These two storm systems account for 65 percent of the moisture received. The third storm system develops in the summer. Moisture from the Gulf of Mexico is transported into the Colorado Plateau, and high-intensity thunderstorms are generated.

The National Weather Service (NWS) and USDA Natural Resources Conservation Service (NRCS) monitor climatic data at several installations surrounding the USCRNA. Table 4 shows the name, record length, elevation, and location relative to the USCRNA for two NRCS snotel sites and four NWS stations in the vicinity. Tables 5-7 contain average climatic data for these sites as posted on the internet. Those who use the USCRNA for research may want to access these internet sites directly for climatic information, rather than relying on the summaries in Tables 5-7. The internet addresses are www.utdmp.utsnow.nrcs.usda.gov for the NRCS snotel sites, and wrcc.sage.dri.edu (Western Regional Climate Center) for the NWS stations.

Table 4. Site data for climatic installations in the vicinity of the USCRNA.

SITE NAME	RECORD LENGTH	ELEVATION	LOCATION RELATIVE TO USCRNA
NRCS SNOTEL			
Donkey Reservoir	1985-Present	9800 ft/2985 m	20 miles (32 km) to NNE
Widtsoe #3	1976-Present	9500 ft/2895 m	18 miles (29 km) to WSW
NWS STATIONS			
Boulder	1954-Present	6700 ft/2040 m	10 miles (16 km) to ESE
Bryce Canyon Airport	1948-1983	7590 ft/2315 m	35 miles (56 km) to SW
Bryce Canyon NP	1959-Present	7910 ft/2410 m	38 miles (61 km) to SW
Escalante	1901-Present	5810 ft/1770 m	11 miles (18 km) to S

Table 5. Average monthly precipitation data for two SNOTEL sites in the vicinity of the USCRNA.

SITE NAME												
OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
DONKEY RESERVOIR												
1.5 in	1.8 in	2.0 in	1.6 in	1.9 in	2.8 in	2.0 in	1.5 in	0.8 in	1.1 in	1.7 in	1.2 in	19.9 in
38 mm	46 mm	51 mm	41 mm	48 mm	71 mm	51 mm	38 mm	20 mm	28 mm	43 mm	30 mm	505 mm
WIDTSOE #3												
1.8 in	2.1 in	2.5 in	1.9 in	2.3 in	3.3 in	2.5 in	1.8 in	0.9 in	1.4 in	2.0 in	1.4 in	23.9 in
46 mm	53 mm	64 mm	48 mm	58 mm	84 mm	64 mm	46 mm	23 mm	36 mm	51 mm	36 mm	607 mm

Table 6. Average monthly precipitation data for four NWS sites in the vicinity of the USCRNA.

SITE NAME												
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
BOULDER												
0.95 in	0.83 in	0.90 in	0.57 in	0.76 in	0.43 in	1.02 in	1.51 in	1.09 in	1.03 in	0.78 in	0.69 in	10.57 in
24 mm	21 mm	23 mm	14 mm	19 mm	11 mm	26 mm	38 mm	28 mm	26 mm	20 mm	18 mm	268 mm
BRYCE CANYON AIRPORT												
0.83 in	1.00 in	1.03 in	0.68 in	0.87 in	0.65 in	1.06 in	1.70 in	1.47 in	1.09 in	0.89 in	0.94 in	12.21 in
21 mm	25 mm	26 mm	17 mm	22 mm	17 mm	27 mm	43 mm	37 mm	28 mm	23 mm	24 mm	310 mm
BRYCE CANYON NATIONAL PARK												
1.42 in	1.58 in	1.47 in	0.89 in	1.08 in	0.57 in	1.31 in	2.32 in	1.68 in	1.27 in	1.15 in	1.11 in	15.83 in
36 mm	40 mm	37 mm	23 mm	27 mm	14 mm	33 mm	59 mm	43 mm	32 mm	29 mm	28 mm	402 mm
ESCALANTE												
0.98 in	0.80 in	0.86 in	0.55 in	0.60 in	0.46 in	1.22 in	1.77 in	1.16 in	1.02 in	0.68 in	0.84 in	10.94 in
25 mm	20 mm	22 mm	14 mm	15 mm	12 mm	31 mm	45 mm	29 mm	26 mm	17 mm	21 mm	278 mm

Table 7. Average monthly maximum and minimum temperatures, and temperature extremes, for four NWS sites in the vicinity of the USCRNA.

SITE NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
BOULDER													
	39.0 F	44.0 F	50.8 F	58.9 F	68.5 F	79.0 F	84.7 F	82.0 F	74.7 F	63.8 F	49.6 F	40.8 F	61.4 F
	3.9 C	6.7 C	10.4 C	14.9 C	20.3 C	26.1 C	29.3 C	27.8 C	23.7 C	17.7 C	9.8 C	4.9 C	16.3 C
	16.4 F	21.0 F	26.5 F	32.9 F	41.7 F	51.0 F	57.8 F	56.3 F	48.7 F	38.5 F	26.3 F	18.2 F	36.3 F
	-8.7 C	-6.0 C	-3.1 C	0.5 C	5.4 C	10.6 C	14.3 C	13.5 C	9.3 C	3.6 C	-3.2 C	-7.7 C	2.4 C
TEMPERATURE EXTREMES: 96 F/36 C HIGH; -17 F/-27 C LOW													
BRYCE CANYON AIRPORT													
	35.1 F	38.6 F	43.4 F	52.7 F	62.9 F	73.7 F	80.0 F	77.1 F	10.8 F	59.6 F	45.5 F	37.4 F	56.5 F
	1.7 C	3.7 C	6.3 C	11.5 C	17.2 C	23.2 C	26.7 C	25.1 C	21.6 C	15.3 C	7.5 C	3.0 C	13.6 C
	4.5 F	8.2 F	14.4 F	22.0 F	29.5 F	36.0 F	44.1 F	43.0 F	35.1 F	25.9 F	15.5 F	7.0 F	23.8 F
	-15.3 C	-13.2 C	-9.8 C	-5.6 C	-1.4 C	2.2 C	6.7 C	6.1 C	1.7 C	-3.4 C	-9.2 C	-13.9 C	-4.6 C
TEMPERATURE EXTREMES: 92 F/33 C HIGH; -32 F/-36 C LOW													
BRYCE CANYON NATIONAL PARK													
	35.8 F	38.7 F	44.3 F	52.8 F	63.2 F	73.9 F	79.6 F	76.8 F	69.6 F	58.9 F	44.5 F	36.8 F	56.3 F
	2.1 C	3.7 C	6.8 C	11.6 C	17.3 C	23.3 C	26.4 C	24.9 C	20.9 C	14.9 C	6.9 C	2.7 C	13.5 C
	9.0 F	12.0 F	17.6 F	23.7 F	31.1 F	39.1 F	46.0 F	44.7 F	36.7 F	27.1 F	18.0 F	10.5 F	26.3 F
	-12.8 C	-11.1 C	-8.0 C	-4.6 C	-0.5 C	3.9 C	7.8 C	7.1 C	2.6 C	-2.7 C	-7.8 C	-11.9 C	-3.2 C
TEMPERATURE EXTREMES: 95 F/35 C HIGH; -26 F/-32 C LOW													
ESCALANTE													
	39.8 F	45.6 F	54.1 F	63.1 F	72.5 F	83.2 F	88.2 F	85.3 F	78.1 F	66.5 F	52.6 F	41.9 F	64.3 F
	4.3 C	7.6 C	12.3 C	17.3 C	22.5 C	28.4 C	31.2 C	29.6 C	25.6 C	19.2 C	11.4 C	5.5 C	17.9 C
	13.5 F	20.2 F	26.1 F	32.4 F	39.6 F	46.8 F	54.0 F	52.4 F	44.0 F	34.6 F	24.0 F	16.0 F	33.7 F
	-10.3 C	-6.6 C	-3.3 C	0.2 C	4.2 C	8.2 C	12.2 C	11.3 C	6.7 C	1.4 C	-4.4 C	-8.9 C	0.9 C
TEMPERATURE EXTREMES: 103 F/39 C HIGH; -22 F/-30 C LOW													

DESCRIPTION OF VALUES

Flora and Communities

Table 8 lists plant species in the USCRNA. Scientific nomenclature follows Welsh et al. (1993), with some commonly-used synonyms included in Table 8 where appropriate. Nomenclature for trees agrees with Little (1979) with one exception: Intermountain bristlecone pine is treated as a distinct species, *Pinus longaeva*, according to Bailey (1970) and in agreement with Welsh et al. (1993) and Cronquist et al. (1972). Field inventories of the USCRNA found no plants federally listed as endangered or threatened, nor any plants considered sensitive by Region Four of the USDA Forest Service. However, not all portions of the area were seen, and some sandstone habitats in the extreme southwestern part of the area could support occurrences of one or more plants on the regional sensitive list.

Four types of plant communities defined by existing vegetation were identified in the USCRNA (see Table 8). These are described in more detail below.

A. *Abies concolor-Pseudotsuga menziesii-Pinus ponderosa* (white fir-Douglas fir-ponderosa pine) mixed-conifer stands, with sparse to very dense tall-shrub understories.

These communities occur primarily in the northern half of the USCRNA, mostly on relatively cool and moist sites such as upper-elevation broad ridge crests and north-facing slopes (Photo 1). They were seen to occur on parent materials of both basalt and the sedimentary Carmel Formation.

Most communities of this type contain mature individuals of *Abies concolor*, *Pseudotsuga menziesii* and *Pinus ponderosa*, with *Juniperus scopulorum* being a common associate. Regeneration of at least the *Abies* and *Pseudotsuga* is also usually present. The density of the overstory canopy is widely variable. Many stands, particularly those on broad ridge crests, are very open with just scattered mature trees present; old snags with fire marks are evident in some of these stands. Other stands on less-exposed north-facing slope positions tend to have more dense coniferous overstories.

Understory vegetation is typically characterized by two species of tall shrubs, *Cercocarpus montanus* and *Quercus gambelii*. These shrubs grow in large, dense thickets where the conifer overstory is sparse (Photo 5), and in more scattered patches where the conifers are more dense. These various density combinations of conifers and tall shrubs may represent different successional stages within a single habitat type, probably the *Abies concolor/Quercus gambelii* h.t. as described by Youngblood and Mauk (1985).

In addition to the two tall shrubs, the low shrubs *Symphoricarpos oreophilus* and *Purshia tridentata* are common in these communities. Graminoids that are typically present include *Elymus spicatus*, *Carex rossii*, *Poa fendleriana*, *Stipa comata* and *Stipa hymenoides*. Common forbs include *Astragalus tenellus*, *Castilleja linariifolia*, *Eriogonum racemosum*, *Hedysarum boreale*, *Hymenoxys acaulis*, *Hymenoxys richardsonii*, *Linum perenne* and *Machaeranthera grindelioides*.

B. *Pinus ponderosa/Purshia tridentata* (ponderosa pine/bitterbrush) communities.

These communities occur primarily in the northern ⅔ of the USCRNA, mostly on gently-sloping broad ridge crests and also locally on steeper east- and west-facing slopes (Photos 1, 2 and 4). They occur mostly on soils developed from the veneer of volcanic rock, chiefly basalt and basaltic andesite (Photo 8), that covers the ground surfaces in this vicinity, though a few stands grow on soils with a mixed volcanic-sedimentary (Carmel Formation) composition.

Table 8. Plant species in the Upper Sand Creek Research Natural Area.

LIFE FORM *Scientific name*[1] [*Synonym*, if any] (common name)	Plant community[2] A	B	C	D
TREES[3]				
Abies concolor (white fir)	X	X		
Juniperus osteosperma (Utah juniper)				X
Juniperus scopulorum (Rocky Mountain juniper)	X	X		
Pinus edulis (two-needle piñon pine)	X	X	X	X
Pinus longaeva (Great Basin bristlecone pine)	X			
Pinus ponderosa (ponderosa pine)	X	X	X	
* *Pseudotsuga menziesii* (Douglas-fir)	X			
SHRUBS AND SUBSHRUBS				
Amelanchier utahensis (Utah serviceberry)	X			
Arctostaphylos patula (greenleaf manzanita)			X	X
Artemisia nova (black sagebrush)	X			
Artemisia tridentata (big sagebrush)	X			
* *Ceanothus fendleri* (Fendler's mountain lilac)		X		
Ceanothus martinii (Martin's ceanothus)		X		
* *Cercocarpus montanus* (birchleaf mountain mahogany)	X			
Chrysothamnus depressus (dwarf rabbitbrush)		X		
Chrysothamnus viscidiflorus (viscid rabbitbrush)	X	X		
Gutierrezia sarothrae (broom snakeweed)	X	X		
Mahonia repens [*Berberis repens*] (Oregon grape)		X		
Purshia mexicana [*Cowania mexicana*] (cliffrose)				X
Purshia tridentata (bitterbrush)	X	X		
Quercus gambelii (Gambel oak)	X	X		
Ribes cereum (wax currant)	X			
Rosa woodsii (Woods rose)	X			
* *Symphoricarpos oreophilus* (mountain snowberry)	X	X		
Tetradymia canescens (gray horsebrush)		X		
GRAMINOIDS				
Bouteloua gracilis (blue grama)	X	X		
* *Bromus tectorum* (cheatgrass)	X	X		
* *Carex occidentalis* (western sedge)		X		
Carex rossii (Ross sedge)	X	X		
* *Carex vallicola* (valley sedge)		X		
Elymus elymoides [*Sitanion hystrix*] (squirreltail)	X	X		
* *Elymus spicatus* [*Agropyron spicatum*] (bluebunch wheatgrass)	X	X		
Koeleria macrantha (junegrass)		X		
* *Poa fendleriana* (mutton grass)	X	X		
Poa pratensis (Kentucky bluegrass)		X		
Poa secunda (Sandberg bluegrass)		X		
Stipa comata (needle-and-thread)	X	X		
Stipa hymenoides [*Oryzopsis hymenoides*] (Indian ricegrass)	X	X		
Stipa lettermanii (Letterman needlegrass)		X		

Table 8 (Continued). Plant species in the Upper Sand Creek Research Natural Area.

LIFE FORM *Scientific name*[1] [*Synonym*, if any] (common name)	Plant community[2] A	B	C	D
FORBS AND SUCCULENTS				
Agoseris glauca (pale agoseris)	X			
* *Androsace septentrionalis* (northern rock jasmine)	X			
* *Antennaria microphylla* (rosy pussytoes)	X	X		
* *Antennaria parvifolia* (common pussytoes)	X			
* *Antennaria rosulata* (breaks pussytoes)	X			
* *Arabis drummondii* (Drummond's rockcress)	X			
* *Arabis holboellii* (Holboell's rockcress)	X			
Artemisia carruthii (Carruth's wormwood)	X			
Artemisia dracunculus (tarragon)	X			
Artemisia ludoviciana (Louisiana wormwood)		X		
* *Astragalus argophyllus* var. *panguicensis* (Panguitch milkvetch)		X		
Astragalus kentrophyta var. *elatus* (tall kentrophyta)	X			
* *Astragalus tenellus* (pulse milkvetch)	X	X		
Calochortus nuttallii (sego lily)	X	X		
Castilleja linariifolia (linearleaf paintbrush)	X	X		
* *Chaenactis douglasii* (Douglas dustymaiden)	X			
Chenopodium fremontii (Fremont's goosefoot)		X		
Cirsium wheeleri (Wheeler's thistle)	X	X		
Clematis columbiana (Rocky Mountain clematis)	X			
* *Comandra umbellata* (bastard toadflax)	X			
* *Crepis occidentalis* (western hawksbeard)	X			
* *Cryptantha fulvocanescens* (yellow-hair cryptanth)		X		
* *Cymopterus purpureus* var. *rosei* (Rose' spring parsley)	X	X		
Dalea searlsiae (Searls prairie clover)	X			
* *Descurainia pinnata* (pinnate tansymustard)		X		
* *Erigeron engelmannii* (Engelmann's daisy)		X		
* *Erigeron eatonii* (Eaton's daisy)		X		
* *Erigeron speciosus* (Oregon daisy)	X			
Eriogonum racemosum (redroot buckwheat)	X	X		
* *Erysimum inconspicuum* (lesser wallflower)		X		
Gayophytum diffusum (diffuse groundsmoke)	X			
Gilia aggregata (scarlet gilia)		X		
* *Hedysarum boreale* (northern sweetvetch)	X	X		
Hymenopappus filifolius (hyaline herb)		X		
* *Hymenoxys acaulis* (stemless woollybase)	X	X		
Hymenoxys richardsonii (Colorado rubberweed)	X	X		
* *Lappula occidentalis* (western stickseed)	X			
* *Lepidium lasiocarpum* (hispidcress)	X			
* *Lesquerella ludoviciana* (silver bladderpod)	X			
Linum perenne (blue flax)	X	X		
Lithospermum incisum (showy stoneseed)	X			
* *Lithospermum multiflorum* (pretty stoneseed)		X		
* *Lotus utahensis* (Utah trefoil)	X	X		

Table 8 (Continued). Plant species in the Upper Sand Creek Research Natural Area.

LIFE FORM *Scientific name*[1] [*Synonym*, if any] (common name)	Plant community[2] A	 B	 C	 D
FORBS AND SUCCULENTS (CONTINUED)				
Lupinus kingii (King's lupine)	X			
* *Lupinus sericeus* var. *barbiger* (sink lupine)		X		
Lychnis drummondii(?) (Drummond's catchfly)		X		
* *Lygodesmia grandiflora* (showy rushpink)	X			
Machaeranthera grindelioides (gumweed aster)	X	X		
Opuntia fragilis (brittle pricklypear)	X	X		
Opuntia polyacantha (central pricklypear)	X			
Pediocactus simpsonii (Simpson's footcactus)	X			
* *Penstemon comarrhenus* (dusty penstemon)	X	X		
* *Penstemon humilis* (low penstemon)		X		
* *Penstemon ophianthus* (Loa penstemon)	X			
Petradoria pumila (rock goldenrod)		X		
* *Phlox austromontana* (desert phlox)	X	X		
* *Physaria acutifolia* (Rydberg's twinpod)	X			
Physaria newberryi (Newberry's twinpod)	X			
Polygonum douglasii (Douglas' knotweed)	X			
Potentilla concinna (pretty cinquefoil)	X			
* *Potentilla crinita* (hair-tuft cinquefoil)	X			
Potentilla gracilis (slender cinquefoil)	X			
* *Senecio multilobatus* (Uinta groundsel)		X		
Solidago canadensis (goldenrod)	X			
Stephanomeria spinosa (spiny wirelettuce)		X		
Stephanomeria tenuifolia (slender wirelettuce)	X			
* *Streptanthus cordatus* (twistflower)	X			
Swertia radiata [*Frasera speciosa*] (elkweed)	X			
* *Tragopogon dubius* (salsify)		X		
Trifolium gymnocarpon (Nuttall's clover)	X			

NOTES:

1. Scientific nomenclature follows: Welsh, S.L., N.D. Atwood, S. Goodrich, and L.C. Higgins, eds. 1993. A Utah flora, second edition. Brigham Young University, Provo, UT. 986 p.

2. Plant communities:
   A. Mixed-conifer (*Abies concolor-Pseudotsuga menziesii-Pinus ponderosa*) stands with sparse to very dense tall shrubs (*Cercocarpus montanus*, *Quercus gambelii*) in understory.
   B. *Pinus ponderosa/Purshia tridentata* communities.
   C. *Pinus ponderosa/Arctostaphylos patula* communities.
   D. *Pinus edulis-Juniperus osteosperma* communities.

3. Nomenclature for trees follows: Little, E.L., Jr. 1979. Checklist of United States trees. USDA Forest Service Agricultural Handbook 541. 375 p.

* Collected and deposited in regional herbaria.

Pinus ponderosa forms a forest canopy that alternates from being moderately dense to very open (Photos 6-8). Regeneration of the pine is present but not especially abundant, probably reflecting the tendency of this species to reproduce episodically. Many of these stands appear to contain a single age class of the ponderosa pine, and evidence of past fires was seen in some communities of this type. Other trees present in lesser amounts are *Juniperus scopulorum* and *Pinus edulis*.

Understories are quite open and savanna-like (Photos 6-8). *Purshia tridentata* forms a patchy low-shrub layer, with lesser amounts of *Symphoricarpos oreophilus* occasionally present. Isolated patches of *Quercus gambelii* occur as well, but not in sufficient quantity to impart a tall-brushy appearance to these communities. A few intermittent clearings within this type were seen to be dominated by *Chrysothamnus viscidiflorus*. Grasses are quite common throughout these communities, with *Stipa comata* and *Poa fendleriana* being the most abundant. Other grasses present include *Elymus spicatus*, *Elymus elymoides*, *Stipa hymenoides*, *Stipa lettermanii* and *Bouteloua gracilis*. Common forbs include *Astragalus tenellus*, *Castilleja linariifolia*, *Erigeron eatonii*, *Eriogonum racemosum*, *Hymenoxys acaulis*, *Hymenoxys richardsonii*, *Linum perenne*, *Lithospermum multiflorum*, *Lotus utahensis* and *Opuntia fragilis*. Overall these communities are remarkably free of exotic, introduced plant species. Only a few small patches of *Bromus tectorum* were seen, perhaps indicative of some type of past localized surface disturbance.

These communities appear to be representative of the *Pinus ponderosa/Purshia tridentata* habitat type described by Youngblood and Mauk (1985). Occasional stands have some minor presence of *Abies concolor* regeneration, but this does not appear to be sufficiently abundant or widespread to "place" all communities of this type in the *Abies concolor* Series. Further, none of the habitat types described for the *Abies concolor* Series match the conditions of these stands as well as the *Pinus ponderosa/Purshia tridentata* habitat type does.

These mature, park-like ponderosa pine stands are the outstanding feature that underlies RNA designation for the Upper Sand Creek site. The best-developed and most laterally-continuous examples of this type are located above the 8200-foot (2500-m) contour in this area, and are thus outside the boundary of the Box-Death Hollow Wilderness. Some of the stands seen during the field inventories have timber volumes and conditions representative of moderately-productive ponderosa pine stands under silvicultural management on the Escalante Ranger District.

C. *Pinus ponderosa/Arctostaphylos patula* (ponderosa pine/greenleaf manzanita) communities.

These communities occur at lower elevations of the USCRNA, chiefly in its southwestern portion (Photo 9) and also scattered along its eastern margin. They occupy sites underlain by the Carmel Formation and especially the Navajo Sandstone. Stands of this type were not traversed directly during the field inventories. From a distance, however, they were seen to consist of open overstories of *Pinus ponderosa* above low-shrubby understories in which *Arctostaphylos patula* was most conspicuous. Further investigation will be needed to describe the floral and other components of these communities more thoroughly.

D. *Pinus edulis-Juniperus osteosperma* (two-needle piñon pine-Utah juniper) communities.

These communities occur throughout the USCRNA, mostly on relatively warm and dry south- and west-facing slopes at low to moderate elevations (Photos 3 and 4). They occur primarily on soils derived from the Carmel Formation (visible in Photo 4) with little or no basalt influence. *Pinus edulis* and *Juniperus osteosperma* form a pygmy woodland that varies from moderately dense to very sparse. *Purshia mexicana* is an occasional associate in these stands. However, not enough communities of this type were traversed during the field inventories to acquire thorough information on additional species composition or other characteristics. As with the preceding vegetation type, further investigation will be needed to describe these piñon-juniper woodland communities more thoroughly.

Fauna [Compiled by Ken Kestner, Wildlife Biologist, Escalante Ranger District]

No federally-listed threatened or endangered species are definitely known to occur within the USCRNA. However, no comprehensive T&E surveys of the surrounding area have been conducted. The surrounding area does have habitat suitable for nesting and foraging of two T&E species: the Peregrine falcon (*Falco peregrinus*; Endangered) and the Mexican spotted owl (*Strix occidentalis lucida*; Threatened). The USCRNA is considered suitable foraging habitat for these two species.

The USCRNA also contains suitable habitat and potential for occurrence of four species considered Sensitive by Region Four of the USDA Forest Service: Flammulated owl (*Otus flammeolus*), Three-toed woodpecker (*Picoides tridactylus*), Northern goshawk (*Accipiter gentilis*), and Townsend's big-eared bat (*Plecotus townsendii*). Management indicator species identified in the Forest Plan (USDA Forest Service 1986b) within the USCRNA include mule deer (*Odocoileus hemionus*), Rocky Mountain elk (*Cervus elaphus*), Wild turkey (*Meleagris gallopavo*), and Northern goshawk (*Accipiter gentilis*).

No systematic studies or inventories have been conducted for animal species in the USCRNA. By matching habitat, species, and species' distribution range, the species listed in Table 9 are likely to inhabit the area or to be found in the area during certain seasons of the year, as during seasonal migration.

Table 9. Animal species likely to occur in the Upper Sand Creek Research Natural Area.

LIFE FORM *Scientific name*	Common name
BIRDS	
Cathartes aura	Turkey Vulture
Aquila chrysaetos	Golden eagle
Accipter striatus	Sharp-shinned hawk
Accipter cooperii	Cooper's hawk
Accipter gentilis	Northern goshawk
Buteo jamaicensis	Red-tailed hawk
Falco tinnunculus	American kestrel
Falco peregrinus	Peregrine falcon
Dendragapus obscurus	Blue Grouse
Meleagris gallopavo	Wild turkey
Columba fasciata	Band-tailed pigeon
Columba livia	Rock dove
Bubo virginianus	Great horned owl
Strix occidentalis lucida	Mexican spotted owl
Otus kennicottii	Western screech owl
Otus flammeolus	Flammulated owl
Glaucidium gnoma	Northern pygmy-owl
Phalaenoptilus nuttallii	Common poorwill
Aeronautes saxatalis	White-throated swift
Archilochus alexandri	Black-chinned hummingbird
Selasphorus platycercus	Broad-tailed hummingbird
Colaptes auratus	Northern flicker
Sphyrapicus thyroideus	Williamson's sapsucker

Table 9 (Continued). Animal species likely to occur in the Upper Sand Creek Research Natural Area.

LIFE FORM *Scientific name*	Common name
BIRDS (CONTINUED)	
Picoides pubescens	Downy woodpecker
Picoides villosus	Hairy woodpecker
Picoides tridactylus	Three-toed woodpecker
Myiarchus cinerascens	Ash-throated flycatcher
Contopus borealis	Olive-sided flycatcher
Contopus sordidulus	Western wood-pewee
Sayornis saya	Say's phoebe
Empidonax oberholseri	Dusky flycatcher
Empidonax hammondii	Hammond's flycatcher
Empidonax difficilis	Western flycatcher
Tachycineta thalassina	Violet-green swallow
Cyanocitta stelleri	Steller's jay
Nucifraga columbiana	Clark's nutcracker
Corvus brachyrhynchos	American crow
Corvus corax	Common raven
Parus inornatus	Plain titmouse
Parus atricapillus	Black-capped chickadee
Parus gambeli	Mountain chickadee
Psaltriparus minimus	Bushtit
Certhia americana	Brown creeper
Sitta carolinensis	White-breasted nuthatch
Sitta canadensis	Red-breasted nuthatch
Sitta pygmaea	Pygmy nuthatch
Catherpes mexicanus	Canyon wren
Salpinctes obsoletus	Rock wren
Thryomanes bewickii	Bewick's wren
Regulus satrapa	Golden-crowned kinglet
Sialia currucoides	Mountain bluebird
Myadestes townsendi	Townsend's solitaire
Catharus guttatus	Hermit thrush
Turdus migratorius	American robin
Vireo vicinior	Gray vireo
Vireo solitarius	Solitary vireo
Vermivora celata	Orange-crowned warbler
Vermivora virginiae	Virginia's warbler
Dendroica coronata	Yellow-rumped warbler
Dendroica nigrescens	Black-throated gray warbler
Dendroica graciae	Grace's warbler
Pheucticus melanocephalus	Black-headed grosbeak
Pipilo chlorurus	Green-tailed towhee
Pipilo erythrophthalmus	Rufous-sided towhee
Melospiza melodia	Song sparrow
Spizella passerina	Chipping sparrow

Table 9 (Continued). Animal species likely to occur in the Upper Sand Creek Research Natural Area.

LIFE FORM *Scientific name*	Common name
BIRDS (CONTINUED)	
Junco hyemalis	Dark-eyed junco
Zonotrichia leucophrys	White-crowned sparrow
Passerella iliaca	Fox sparrow
Icterus galbula	Bullock's oriole
Piranga ludoviciana	Western tanager
Carduelis pinus	Pine siskin
Loxia curvirostra	Red crossbill
Carpodacus cassinii	Cassin's finch
Coccothraustes vespertinus	Evening grosbeak
MAMMALS	
Felis rufus	Bobcat
Felis concolor	Mountain lion
Odocoileus hemionus	Mule deer
Cervus elaphus	Rocky Mountain elk
Ursus americanus	Black bear
Urocyon cinereoargenteus	Gray fox
Erethizon dorsatum	Porcupine
Bassariscus astutus	Ringtail
Canis latrans	Coyote
Mustela erminea	Ermine
Sylvilagus nuttallii	Nuttall's cottontail
Spilogale putorius	Spotted skunk
Mephitis mephitis	Striped skunk
Marmota flaviventris	Yellow-bellied marmot
Tamiasciurus hudsonicus	Red squirrel
Spermophilus variegatus	Rock squirrel
Eutamias minimus	Least chipmunk
Peromyscus boylii	Brush mouse
Peromyscus maniculatus	Deer mouse
Microtus longicauda	Long-tailed vole
Tadarida macrotis	Big free-tailed bat
Tadarida brasiliensis	Brazilian free-tailed bat
Plecotus townsendii	Townsend's big-eared bat
Pipistrelle hesperus	Western pipistrelle
Lasionycteris noctivagans	Silver-haired bat
Myotis californicus	California myotis
Myotis yumanensis	Yuma myotis
Myotis lucifugus	Little brown bat

Table 9 (Continued). Animal species likely to occur in the Upper Sand Creek Research Natural Area.

LIFE FORM *Scientific name*	Common name
REPTILES	
Gambelia wislizenii	Longnose leopard lizard
Phrynosoma douglassi	Short-horned lizard
Uta stansburiana	Side-blotched lizard
Urosaurus ornatus	Tree lizard
Cnemidophorus tigris	Western whiptail lizard
Masticophis taeniatus	Striped whipsnake
Thamnophis elegans	Western terrestrial garter snake
Crotalus viridis	Western rattlesnake
Pituophis melanoleucus	Gopher snake
AMPHIBIANS	
Scaphiopus intermontanus	Great Basin spadefoot toad

Geology

The region in which the USCRNA lies has been the subject of geologic mapping efforts by Detterman (1956), McFall and Peterson (1971), Hackman and Wyant (1973), Doelling (1975), Sargent and Hansen (1982), and Williams (1985). The most detailed and recent treatment of the geology of the area that includes the USCRNA is provided by Weir et al. (1990), and it is from this latter source that the following descriptions derive.

The lowest, oldest rocks in the USCRNA are the Navajo Sandstone, of upper Triassic(?)/lower Jurassic age. Extensive outcrops of Navajo Sandstone occur in the southwestern portion of the RNA, where they are largely occupied by ponderosa pine/manzanita communities (Photo 9); narrower exposures occur along the lower eastern and western margins of the area. The Navajo consists of cross-bedded sandstone that is mostly very light grayish-orange, and locally reddish-gray to yellowish-orange. The rock is poorly to well cemented by calcite and readily weathers to yield loose sand. The Navajo Sandstone erodes to form high cliffs, fin-shaped ridges, and irregular rounded knobs. In the southwestern part of the USCRNA, the exposed upper surface of the Navajo Sandstone is cut by many vertical and near-vertical joints which are closely spaced and, though locally obscure, are generally conspicuous because they control small landform features.

Overlying the Navajo Sandstone in the USCRNA is the upper member of the Jurassic-age Carmel Formation. This stratum forms the substrate through much of the central and northern portions of the USCRNA (see left-central part of Photo 4), except where it overlain by a veneer of younger volcanic rocks (see following paragraph). The Carmel upper member is composed of shale interbedded with minor amounts of sandstone, limestone and gypsum. The shale is silty to clayey, commonly calcitic, mostly grayish-yellow but in part reddish-brown mottled with light gray and light green. It is laminated to thin-bedded and weathers readily to form a slope littered with small chips. The sandstone is reddish-brown and yellowish-gray, very fine to fine grained and silty, in part calcitic, rarely gypsiferous, and poorly to firmly cemented. The sandstone is mostly in thin horizontal beds. Locally-conspicuous are small-scale trough and planar sets of crossbeds, grouped into small ledge-forming lenses. The limestone is grayish-

yellow to yellowish-gray and is commonly silty and dolomitic and locally grades to dolomite. The limestone is in laminae and thin beds that are commonly ripple marked. A few beds contain fragments of pelecypods and other comminuted shell material. The limestone generally forms ledges that weather to yield abundant platy fragments to the slopes below. Very light gray to brownish-gray, clayey to sandy gypsum occurs sporadically in thin horizontal beds and irregular lenses, as much as about 4 feet (1.2 m) thick and 100 feet (30 m) long. Most gypsum layers and enclosing beds are more or less contorted. The total thickness of the Carmel Formation upper member ranges from about 300 to 600 feet (90-180 m).

Forming a discontinuous veneer on the upper surface of the Carmel Formation, primarily in the northeastern, central and southeastern portions of the USCRNA, is a unit named by Weir et al. (1990) as Mixed-lithology creep colluvium. These areas consist of unconsolidated Quaternary-age deposits of subangular to well-rounded pebbles to large boulders of dark-gray basaltic andesite, derived from highlands of the Aquarius Plateau to the north, commonly mixed with blocks of sandstone, limestone and mudstone from the underlying Carmel Formation. These deposits are probably as much as 30 feet (9 m) thick, and support some of the best examples of ponderosa pine/bitterbrush communities in the USCRNA (Photo 8).

Soils

The Soil Resource Inventory of the Dixie National Forest identifies four soil map units within the boundary of the USCRNA. Brief information about these units is presented below. More detailed descriptions and interpretations of the soils in these map units appear within the Soil Resource Inventory report, and are reproduced in Appendix G of this Record.

- Unit 435: Blanchard, variant family - Rock outcrop complex, 15 to 60 percent slopes.
  Shallow soils on steep sandstone canyon sideslopes with ponderosa pine.
  50% Lithic Ustipsamments, mixed, frigid
  35% Rock outcrop

- Unit 444: Frandsen - Syrett families complex, 10 to 40 percent slopes.
  Deep soils on Carmel Formation and basaltic andesite sideslopes with ponderosa pine.
  45% Typic Ustorthents, fine-loamy, mixed (calcareous), frigid
  35% Entic Haploborolls, loamy-skeletal, mixed

- Unit 521: Rock outcrop (sandstone).

- Unit 532: Quilt family, 10 to 60 percent slopes.
  Very deep soils on Quaternary creep colluvium (volcanic-rock and mixed-lithology) with Gambel oak.
  85% Typic Argiborolls, fine, montmorillonitic

Lands

The USCRNA is entirely reserved National Forest System land. Approximately 70% of the RNA lies within the Box-Death Hollow Wilderness. The 30% of the RNA outside the Wilderness has been withdrawn (by the 1984 Utah Wilderness Act) from all forms of appropriation under the mining laws and from disposition under all laws pertaining to mineral and geothermal leasings -- except that the area may be leased for carbon dioxide (CO_2).

Cultural

No formal cultural resource inventory work has been done within the boundary of the USCRNA. The potential for presence of prehistoric archaeological resources within the USCRNA is low to moderate,

based on findings of a few sites from Archaic through Piute times in the vicinity of the area. In historic times, the USCRNA supported a few small, transient livestock camps. RNA field inventories in 1997 found scattered rusty metal cans in two locations, plus remains of an old stove in one, that appear to be the sites of such old camps.

Other

The Upper Sand Creek RNA contains no other known features of local (or wider) importance.

IMPACTS AND POSSIBLE CONFLICTS

Mineral Resources

Impacts and possible conflicts with respect to mineral resources of the USCRNA differ between the Wilderness and non-Wilderness portions of the area. The part of the USCRNA within the Box-Death Hollow Wilderness was identified in the Forest Plan as being within Management Area 8A, for which management direction states that:

- No new leases may be issued for oil, gas or geothermal resources;
- No permits may be issued for common variety (salable) mineral resources; and
- The area is withdrawn from mineral entry, so that no new claims can be located -- though valid existing rights could exist on claims located prior to the mineral withdrawal that was emplaced by the 1984 Utah Wilderness Act.

These directions will remain in place for the Wilderness portion of the USCRNA, even though RNA designation adds Management Area 10A to the existing 8A status.

Records maintained by the Bureau of Land Management (BLM) show that the Wilderness portion of the USCRNA contains no valid existing geothermal or oil and gas leases. Further, BLM geographic-index microfiche dated 8/18/98 show that the Wilderness portion of the USCRNA contains no valid existing mining claims (where "valid" refers to claims that were located prior to the 1984 Utah Wilderness Act **and** that have been kept active via annual assessment or payment). In fact, the microfiche show no mining claims of any sort, active or not, within the entire area of T33S R3E.

The part of the USCRNA outside the Box-Death Hollow Wilderness was identified in the Forest Plan as being within Management Area 8A2. Management direction for this area states that all lands are withdrawn (by virtue the 1984 Utah Wilderness Act) from all forms of appropriation under the mining laws and from disposition under all laws pertaining to mineral and geothermal leasings and all amendments thereto, with one exception: Competitive leases for carbon dioxide (CO_2) may be issued for a period of five years from the date of enactment of the 1984 Utah Wilderness Act (PL 98-428), and any lease issued for CO_2 will be valid for a period of ten years and for so long thereafter as CO_2 is produced annually in commercial quantities from that lease.

These management directions will remain in place for the non-Wilderness portion of the USCRNA, even though RNA designation changes the Management Area identity from 8A2 to 10A.

The non-Wilderness portion of the USCRNA is covered by one existing CO_2 lease, #U65084. The BLM oil and gas plat for T33S R3E, dated 2/28/96, shows this lease with a status of "CO_2 Lse Comp". BLM microfiche dated 8/18/98 show that no mining claims, either valid (as defined three paragraphs above) or not, exist in the non-Wilderness portion of the USCRNA or anywhere else in T33S R3E.

Therefore, the only mineral-related activity allowed within the non-Wilderness portion of the USCRNA is the exploration and possible production of CO_2. The Environmental Assessment accompanying this Establishment Record (USDA Forest Service 1998b; see Appendix C) acknowledges that "designation of the [Upper Sand Creek] area as an RNA would place no further restrictions upon CO_2 production beyond those contained in the Utah Wilderness Act". The Decision Notice and Designation Order proceeding from the Environmental Assessment states that the Forest Service will honor all existing and lawful renewals of mineral or oil and gas leases, and this activity shall be managed as the priority land management feature for as long as the leases exist.

According to the Environmental Assessment, the expiration date of the existing CO_2 leases -- assuming no annual production of commercial quantities of CO_2 -- is June 1, 1999. In other words, if the valid existing lease covering the non-Wilderness part of the USCRNA is not producing commercial quantities of CO_2 by this date, then that CO_2 lease will be closed. If such lease expiration/closure should occur, then there will be no future mineral-related conflicts with RNA status of the entire USCRNA.

Grazing

The USCRNA lies within the boundary of the Sand Creek C&H allotment. This allotment is used by three permittees, with a total permitted use on the entire allotment of 754 cow-calf pairs from June 16 to October 15. Cattle movement (rotation) patterns used on the allotment are intended to keep the livestock to the east of Sand Creek. There is no purposeful grazing use in, nor herding of cattle toward, the area of the USCRNA. Cattle may occasionally drift to the west of Sand Creek, but the likelihood of casual, incidental grazing use in the USCRNA is very low.

Designation of the USCRNA will not change the existing situation for grazing. The USCRNA will not be closed to domestic livestock grazing, nor will adjustments be made to term grazing permits on the Sand Creek allotment as a result of the RNA designation. The Forest will not place any range improvements within the USCRNA, and no effort will be made to move cattle toward or into the area purposely.

With respect to RNA management, livestock grazing will not be used as a management tool to maintain vegetation communities in the USCRNA. There are no existing fences in the area, none are needed, and no change in management is necessary in lieu of fencing. Maintenance of the current grazing situation on the Sand Creek allotment will result in an acceptable level of casual or incidental livestock use that can be tolerated within the USCRNA. Occasional livestock that may stray into the area will be managed by working with the permittee(s) under terms of the grazing permits.

Given the situation and conditions described above, establishment of the USCRNA poses no conflicts with grazing management on the Sand Creek C&H allotment.

Timber

The total forested area of the USCRNA is about 1145 acres (463 ha). Forested lands within the Box-Death Hollow Wilderness, under Management Area 8A in the Forest Plan (USDA Forest Service 1986b), are not part of the suitable timber base on the Dixie National Forest. Regarding the non-Wilderness portion of the USCRNA, no timber resources were allocated to Management Area 8A2 in the current Forest Plan. Under the present management situation, therefore, designation of the USCRNA will result in no values being withdrawn from the timber producing base.

Watershed Values

The USCRNA contains no perennial water sources, wetlands or riparian habitats. The area does contain a number of ephemeral or intermittent drainage courses, as shown on topographic maps of the

area (see Map 4). In general, the area provides good-quality groundwater to adjacent drainage basins. Portions of the USCRNA that are underlain by volcanic parent materials have a relatively low natural erosion hazard, and are not a significant source of sediments to surrounding drainages. Areas where the Carmel Formation is exposed have higher erosion hazard ratings. However, these areas are generally not a major source of sediments because they are moderately well vegetated and their slopes are not uniformly very steep. Exposures of the Carmel Formation do have the potential to be an erosion problem if their surfaces are disturbed, which would not happen under RNA management. RNA designation should have no impact on the watershed properties of this area.

Recreation Values

The Escalante Ranger District has begun to see an upturn in recreational use overall, as a "spillover" effect of the creation of the Grand Staircase-Escalante National Monument. In general this increase in use has been more motorized than non-motorized, and thus does not have any direct effect on the USCRNA specifically.

The USCRNA is not tied in to any trail systems or traversed by established travel routes, and thus does not receive recreational use by people en route to other destinations. The RNA may be a destination in itself for occasional hikers, backpackers and horseback riders who come to enjoy scenic vistas, explore remote terrain, view wildlife, or pursue hunting opportunities. Such uses currently occur at low levels, and appear to be having little adverse impact on the USCRNA at the present time. The Forest has no plans for developed trails or recreational facilities in the area, and the absence of reliable water sources in the area may tend to hold down future levels of recreational use.

Wildlife and Plant Values

Designation and management of the USCRNA will maintain suitable habitat for special-status animals and plants that are known or likely to occur in the area.

Special Management Area Values

Management direction for the part of the USCRNA within the Box-Death Hollow Wilderness will meet statutory mandates for the Wilderness (FSM 1920). Designation of the USCRNA should have no affect on the management of the Wilderness or the purposes for which it was established.

Transportation Plans

The northern end of the USCRNA is slightly less than ½ mile (0.8 km) south of the closest approach of the well-traveled Hells Backbone road. The RNA itself contains no roads or constructed/maintained trails, and no such routes lead into it from the Hells Backbone road. There are no transportation plans on the Dixie National Forest that would have direct adverse effects on the USCRNA. Conversely, designation of the USCRNA should have no effect on the Dixie National Forest transportation system. The only potential for road construction in the USCRNA would be in conjunction with valid existing CO_2 leases, as explained above in the **Mineral Resources** section.

The portion of the USCRNA in the Box-Death Hollow Wilderness is closed yearlong to all motorized vehicles. The portion outside the Wilderness, and particularly the approach into the RNA from the Hells Backbone Road, is relatively rough, brushy terrain that does not readily lend itself to travel by all-terrain vehicles.

MANAGEMENT PRESCRIPTION

In order to meet and maintain the objectives for which the USCRNA is established (see the **OBJECTIVES** section of this Record), various management standards and prescriptions will apply to the area. General standards for RNA protection and management are contained in the Forest Service Manual, Section 4063.3. More specific management prescriptions for RNAs on the Dixie National Forest appear on pages IV-153 through IV-155 of the Forest Plan (USDA Forest Service 1986b); these pages are included in Appendix B of this Record. A synopsis of the management standards and prescriptions for the USCRNA, drawn from these sources, is provided below.

Emphasis for use of the USCRNA is on research, observations, monitoring, and educational activities that are nondestructive and nonmanipulative. Management of the USCRNA will be directed toward maintenance of unmodified conditions and natural ecological processes. The future condition of the USCRNA will be shaped by natural forces only (except for the presence of approved research markers and equipment), and human activities that directly or indirectly modify ecological processes will not be permitted within the area.

Use of the USCRNA by scientists and educators is strongly encouraged. Special-use permits or cooperative agreements will be used to authorize and document scientific activity. Any public use that contributes to impairment of research or educational values will be discouraged or prohibited. Guidelines for scientific and educational use of the USCRNA are contained in FSM 4063.33.

Logging activities, harvest of woodland products, fuelwood gathering, and direct habitat manipulation for wildlife are prohibited within the USCRNA. The District and Forest should show the USCRNA as a closed area on firewood cutting maps that are distributed to the public.

The USCRNA will not be closed to domestic livestock grazing, nor will adjustments be made to term grazing permits on the Sand Creek C&H allotment as a result of the RNA designation. Range improvements will not be placed within the USCRNA. No effort will be made to move cattle toward or into the area purposely. Livestock grazing will not be used as a management tool to maintain vegetation communities in the USCRNA. No fences are needed in the area, and no change in grazing management is necessary in lieu of fencing. Maintenance of the current grazing situation on the Sand Creek allotment will result in an acceptable level of casual or incidental livestock use that can be tolerated within the USCRNA. Occasional livestock that may stray into the area will be managed by working with the permittee(s) under terms of the grazing permits. Overnight pasturing of recreational pack stock is not permitted within the USCRNA.

Construction of developed recreation sites and establishment of permanent camps are prohibited within the USCRNA. Use of the USCRNA by Outfitter and Guide operations will not be permitted. Other recreational use of the USCRNA is not expressly prohibited, but such use will not be encouraged so that the scientific and educational values of the area can be emphasized. The effects of recreational uses (if any) that occur within the USCRNA will be evaluated periodically. Any such uses that are found to be threatening or interfering with the objectives for which the USCRNA was established will be prohibited. Indicators of unacceptable degradation include the appearance of social trails, creation of campsites, campfire rings, unnatural erosion patterns, and other indications of significant recreational use.

No roads, trails, fences, signs, buildings or other physical improvements will be permitted within the USCRNA, unless they contribute to the objectives or protection of the area or unless they are associated with valid existing CO_2 leases within the area.

Special closures may be used when necessary to protect the USCRNA from actual or potential damage from public use, or to prohibit uses that are incompatible with the area's objectives, according to provisions of 36 CFR 261.50 (see also FSM 4063.3.6).

Fire hazard will not be reduced within the USCRNA. Natural fires within the USCRNA will be allowed to burn only within the parameters of an approved fire plan, and only under a prescription designed to accomplish the objectives of the area. Until such a plan has been approved by the Regional Forester in consultation with the Rocky Mountain Research Station Director, fires will be suppressed using means that will cause minimal damage to the USCRNA. Use of heavy equipment in suppression efforts is strongly discouraged, and should be used only as a last resort. Use of chemical fire retardants in the USCRNA likewise is strongly discouraged. Fire-caused debris will be left for natural decay, and post-fire rehabilitation is not recommended. If such rehabilitation must be done, as in cases of extreme flood or erosion hazards to people or property outside the USCRNA, then only seeding with locally adapted ecotypes of indigenous species should be utilized.

No actions will be taken against endemic insects, diseases, wild plants or animals in the USCRNA, unless the Regional Forester and Station Director deem such actions necessary to protect the features for which the USCRNA was established or to protect adjacent resources.

Introduction of exotic plant or animal species into the USCRNA is prohibited, and precautions will be taken to avoid such introductions. Insofar as is practical, measures will be taken to control or eradicate existing or new occurrences of exotic plant or animal species from the USCRNA, particularly those that readily invade native communities and/or alter natural ecological conditions. If re-seeding is needed following a fire (as mentioned above), then the seed mix will not contain non-native plant species. If pack stock are determined to be a vector for introduction of non-native plant species, then weed-free feed requirements will be implemented.

Where pest management or noxious weed control activities are necessary within the USCRNA, they will be as specific as possible against target organisms, and will induce minimal impacts to natural values and other components of the ecosystem.

Within the portion of the USCRNA located within the Box-Death Hollow Wilderness, no new leases may be issued for oil, gas or geothermal resources; no permits may be issued for common variety (salable) mineral resources; and the area is withdrawn from mineral entry, so that no new claims can be located.

The non-Wilderness portion of the USCRNA is withdrawn from all forms of appropriation under the mining laws and from disposition under all laws pertaining to mineral and geothermal leasings and all amendments thereto, with one exception: Leases for carbon dioxide (CO_2) have been issued and are valid for a period of ten years, and for so long thereafter as CO_2 is produced annually in commercial quantities from the leases. The Forest Service will honor all existing and lawful renewals of mineral or oil and gas leases, and this activity will be managed as the priority land management feature for as long as the leases exist. The CO_2 lease covering the non-Wilderness part of the USCRNA is due to expire on June 1, 1999, if commercial quantities of CO_2 are not being produced by that date.

Management direction for the part of the USCRNA within the Box-Death Hollow Wilderness must meet statutory mandates for the Wilderness (FSM 1920).

Vegetation Management

As mentioned above in the **MANAGEMENT PRESCRIPTION** section, domestic livestock grazing will not be used as a management tool to maintain vegetation communities in the USCRNA.

Fire plays an important functional role in the ponderosa pine forests of the USCRNA, especially in the ponderosa pine/bitterbrush communities. The "natural" or pre-settlement fire regime in these forests was largely one of fairly frequent, low-intensity ground fires that cleaned out the buildup of fuels in the

forest understory. Over time, however, fire suppression alters this "natural" fire regime and leads to changes in the structure and function of these communities. In particular, the long-term absence of fire allows understory vegetation to increase in height to where it mingles with the overstory canopy. In such situations, fire may follow these ladder fuels from the ground up into the overstory canopy layer, resulting in catastrophic crown fires that are highly destructive to the ponderosa pine forest.

Therefore, inventory, monitoring and research should emphasize the role of fire as a natural process governing these ponderosa pine communities, and evaluate the risk of continued wholesale fire suppression. Such knowledge should be incorporated into an approved fire plan for that portion of the Forest in which the USCRNA lies, and allow for conditions under which certain naturally-ignited fires may be allowed to burn within the USCRNA. Such a plan will identify those parts of the USCRNA that are allocated for prescribed non-suppression of naturally ignited fires, and those parts that are reserved for permanent suppression of fire (per FSM 4063.41.5.j(1)).

Monitoring

To ensure that only authorized use is occurring and to determine if any threats may be imminent, the USCRNA should be visited annually or biennially by Forest Service personnel or a cooperative partner. A stewardship monitoring module prepared by the Natural Areas Program Office in Missoula MT is available for use in documenting the results of such general monitoring visits.

Establishment of permanent monitoring plots is encouraged within the USCRNA. These would provide information required to manage effectively and protect the area over time. Long-term ecological monitoring in RNAs will make significant contributions to understanding of how ecosystem patterns and processes change over time.

ADMINISTRATION, RECORDS AND PROTECTION

Administration, records and protection of the USCRNA are the ultimate responsibility of the Director of the Rocky Mountain Research Station. The Station Director, in consultation with the Forest Supervisor, Dixie National Forest, and District Ranger, Escalante Ranger District, will approve all management plans and oversee and coordinate approved research. The Forest Supervisor will execute approved management plans for the USCRNA and administer, manage and protect the area. The District Ranger has responsibility for direct administration, protection and management of the USCRNA in accordance with this Establishment Record, Forest Plan management direction, and any subsequent management plans for the USCRNA.

Requests to conduct research within the USCRNA are referred to the Station Director, who will be responsible for any studies or research conducted. The Station Director will evaluate research proposals, and will coordinate the activity with the District Ranger prior to the initiation of any project. All plant and animal specimens collected in the course of research conducted in the USCRNA will be deposited with the Monte L. Bean Life Science Museum and Herbarium at Brigham Young University, and/or with federal agency herbaria and museums approved by the Station Director.

Records for the USCRNA will be maintained in the following offices:

Intermountain Region, Ogden, UT
Dixie National Forest, Cedar City, UT
Escalante Ranger District, Escalante, UT
Rocky Mountain Research Station, Ogden, UT

ARCHIVING

The Research Natural Area Coordinator at the Intermountain Regional Office, Ogden, UT, will be responsible for maintaining the USCRNA research data files, including studies conducted in the USCRNA, lists of plant and animal species and plant communities occurring within the USCRNA, and lists of herbarium and museum specimens collected. Descriptive data from the USCRNA will also be stored in the computerized natural areas database maintained by the Utah Natural Heritage Program in Salt Lake City, UT.

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